
CHAPTER ONE

INTRODUCTION

For thousand of years early man lived in the river valleys and used the rivers as a source of food, water for drinking, agriculture and for transportation. But he probably had little or no impact on the ecosystems of the rivers. However, within ever a hundred years the modern man, with his culture, has had a tremendous impact on the ecosystem of the river and its flood plain. Early man was a natural part of the ecosystem of the river and its basin. Basically modern man, too, is a part of this ecosystem, but his culture has severed his thinking, mode of living and activities from the natural environment. The aloofness of modern man from his environment is mainly a result of such features of his culture as religion, science, technology, politics and economics. According to Sturrett (1972) economics and politics have played the important background role in man's cultural activities on the rivers and their basins.

Rivers are the life lines of nations and threads from which their history is woven. Rivers and their shores are precariously balanced, interacting ecosystems, easily upset by man. Man at any stage in culture and at any density is closely associated with and modifies rivers and streams.

According to the Oxford dictionary, the word 'stream' is an all inclusive term for flowing water. A river, therefore, is a type of stream. But generally we think of a river fairly large, flowing body of water whose characteristics are largely determined by the geology, topography, soils and land use of the watershed. Rivers may also be affected by pollutants in

the atmosphere and by other activities in the catchment area.

A river system comprises streams with a shared history of tectonics and marine invasions. The mainstem environment is subject to tributary inflows often with distinctive physical, chemical or biological features, but generally with an underlying common character; they are networks which together express the totality of the catchments they drain. Fish and other organisms may range widely through the water ways of the system, exploiting different resources or the same resource at different times. The flora and fauna may have been isolated sufficiently long to acquire a distinctive genetic character, endowing the system with a degree of biogeographic integrity. A river system, therefore, is a logical environmental unit for management and indeed, given the complexities of large river systems, the only practical unit for management, with the component river basins regarded as sub-units.

Fish provide the most valuable biological yield from rivers and are the end result of the productivity of the ecosystem. Rivers are often very productive due to the contribution of organic matter from their catchments. Some of the more valuable commercial species of fish spawn and reared in rivers.

None of the world's river systems is unaffected by man, and there are extensive plans for further development. People often are unaware that quite different plant and animal communities inhabit rivers and that a single dam on a river

system profoundly alters that river system for some distance below the discharge point.

Our knowledge of the ecology of these waters is scanty and therefore predictions of the long term ecological effects produced by the works of man remain of a general nature.

Indian inland fisheries resources are amongst the richest in the world. The principal rivers of India, their main tributaries, the canals and irrigation systems stretch for about 1,40,000 km. The reservoirs and lakes cover an area of 2.9 million hectares. Only the main river and rivulets run for about 29,918 km (Jhingran, 1983).

Inland fish production according to Agarwal & Narain (1985) has been increased from .69 million tonnes in 1979 to 0.95 million tonnes in 1981. However, a large part of increase came from aquaculture. Some other sources quote that the inland fish production in the country increased from 0.69 million tonnes in 1971 to 1 million tonnes in 1984 and 1.13 million tonnes in 1985 (India, 1986). In 1974 the inland fish yield in Maharashtra was around 16,350 tonnes. This increase in the inland fish production, particularly from aquaculture, marks the extremely distressing situation of riverine fisheries because of increasing river pollution and construction of dams. The riverine fish catch may actually be declining at an alarming rate but there is no information or statistics available with the government. Also some of the most productive lakes like Dal lake in Kashmir are steadily dying because of pollution which has threatened the livelihood of 50,000 fisherfolk in the

region (Agarwal and Narain, 1985).

In India the rivers and their tributaries play a major role in supply of drinking water, irrigation, navigation, hydel power generation, industrial purpose and fisheries.

Fish production from rivers has a great significance in the life of people in India. As this is perhaps the main source of cheap but essential animal protein to the millions of poor rural people. In addition the fish is sold locally and used for subsistence purpose. In the rural setting it does not require preservation and transportation which reduce the costs of distribution. Also the riverine fisheries provide job opportunities to millions of rural people.

The entire catch of inland fish is directly utilized as human food and very little quantity is used for fertilizer purpose. The catches mainly include major carps, cat fishes, murrel etc. The fishing intensity along the course of river varies from stretch to stretch, depending upon the current, velocity, and terrain of the river beds.

The riverine fishing is very diffused in nature. Also it is not possible to collect information regarding the riverine fish production, total number of fishermen engaged in fisheries and number and type of gears employed in the different zones of rivers in the country (GOI 1976).

The rapid advancement of unplanned industrial development in the country has played an adverse role in the riverine ecosystem and the quality of all the river waters in ^{the} country

has become deteriorated (Agarwal et al., 1982). Usually the river is the only source which is easily available for discharging of industrial and municipal wastes. In India, the rivers have been abused for long owing to the absence of any legislation till 1974 and also largely due to the complete negligence towards the protection of freshwater resource. The condition of Ganga, Yamuna, Hoogly, Godavari, Cauvery and Krishna and all most all the minor rivers in the country is very bad (Agarwal et al., 1982). According to the same authors 70 % of India's fresh water is polluted.

Most of the cities and towns in India are unequipped with proper sewage treatment facilities and huge quantities of untreated sewage is discharged in these rivers. They are further subjected to pollution by indiscriminate disposal of industrial wastes from pulp and paper mill, textiles, tanneries, sugar distilleries, coal washeries, petro chemicals, atomic power plants and other industries. These rivers are also used for other purposes like mass bathing, cloth washing, cattle washing and religious use, thus further increasing the pollution load. Besides this the large amount of agricultural run-off containing residue of fertilizer and pesticides also had enhanced pollution of rivers. The combined effects of these human activities has caused gross pollution of rivers in India.

Most of the waste discharge into river contain very high quantity of organic matter, heavy metals, pathogenic organism, toxic chemical compound and oils etc. (Aswanikumar et al., 1985).

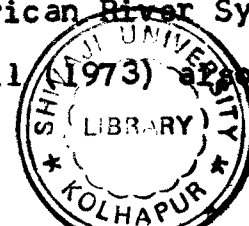
The wastes have high biochemical and chemical oxygen demand. They rapidly consume the dissolved oxygen of water, therefore mass fish mortality occurs due to rapid depletion of dissolved oxygen in water and toxic effects of industrial waste and aquatic organisms are affected by pollutants both directly and indirectly in various ways. There are recurrent incidents of mass fish mortalities in the Panchganga River System. The fishes are affected directly or indirectly due to water pollution, as follows. Destruction of their habitual food organisms by the covering of the bottom of water body by waste material greatly reduces the food supply of fish. Blocking of migration channel may be adversely affected by highly localized pollution of the river. Destruction of spawning ground can be serious in respect of major carps and other fishes which require special environment for breeding. Mechanical injury or blocking of gills from silt or other suspended material shows mortality.

Since past few decades a decline in fish and fisheries has been observed in the world due to the water pollution (Jhingran, 1983). Several research workers all over the world, have made their contribution to the different aspects of fish and fisheries. Initially the limnologists and fishery biologists concentrated on the abiotic and biotic parameters from small stretches of streams and rivers. Fish research was mainly conducted for taxonomic significance than actual fishery survey. Also they gave emphasis to the fish fauna from different geographic regions, altitudes, topography, temperature etc.

Some of the workers who have done extensive work on fish

or fisheries abroad are McPhail (1967), Geister et al. (1975), Goto et al. (1978), Chang-Kue et al. (1980), Martin (1980), Angermeier and Karr (1983), Cross (1985), Courtenay et al. (1985), Eckman (1985), Fago (1985), Petrere (1985), Risotto and Turner (1985), Lloyd and Walker (1986), Propst and Earls (1986), Balen et al. (1986). FAO (1970) has listed 162 fish species from the Niger-Benne river complex. Starrett (1972) reports that during the past 100 years 121 species of fish have been collected from the Illinois River in USA. Out of these many species which were common before 1908, now are rare or limited in their distribution. The changes which have occurred in the fish fauna of the Illinois river reflect some of the drastic effects modern man has done on the ecology of the river. Goto and Nakanishi (1978) studied ecology and zoogeography of 31 fish species from rivers in Hokkaido island in Japan. Martin (1980) investigated, under natural environmental conditions, trout, salmon and eel population migrations in two streams in Canada. Angermeier and Karr (1983) reported the dynamics of prey predation relationships among fishes in 9 forested stream in Central Panama.

There are some workers who have studied fishes of independent river system. Skelton (1986) has given an account of fishes and their distribution from Orange Vaal River system from South Africa. Banister (1986) reported that Zaire River System has more fish species than any other African River System (700 species out of which 500 are endemic), Poll (1973) also



suggested distribution and, ecology of the major units in the system. Welcomme (1986) has given a detail account of fishes from the Niger River System. Cadwallader (1986) has reviewed the reproductive adaptations of the native fish whose life cycles are completed wholly within the Murray-Darling River System, he has also discussed the effects of man on these species, and the distribution of native and introduced fish in a small southern tributary.

In India Hora (1940), Jones (1946), Khan (1946), Chacko and Ganapati (1949), Chacko (1952), Jones and Sarojine (1952), Job et al. (1955) Banerjea et al. (1956), Kalawar and Kelkar (1956), Majumdar (1958), Dubey and Mehra (1959), David et al. (1959), David (1963a,b), Mahajan (1965), George et al. (1966), Ray and David (1966), Karamchandani et al. (1967), Karamchandani and Pisolkar (1967), Grover and Gardola (1977), Johas and Dhillon (1981), Joshi (1983), Agarwal (1983), Yazdani and Gupta (1983), Johal and Tandon (1984), Johal and Sharma (1986), Sharma and Rajput (1986) are some of the workers who studied fish and fisheries in different rivers.

Perhaps the first extensive survey of fisheries in pre-independent India was done by Khan (1946) on River Indus, in the 400 km. stretch in the three districts now in Pakistan. He found out that fishermen being very poor could not invest in fishing gear and the deeper waters in main river were unexploited. The fishing was mainly done by cast net, dip net, drag net and stake net in side streams and pools, he also gave an account of marketing.

Chacko et al. (1954) surveyed in detail the fisheries of the Cauvery river. About 80 species including 6 exotic species were reported. The fish catch from river comprised 66% of the inland fisheries revenue of the earlier Madras State. Setna and Kulkarni (1946) studied the fisheries in the river Sabarmati and its many tributaries around Ahamadabad, the authors reported 46 fish species. Job et al. (1952) have given an excellent report of the fisheries of the Damodar Basin and the impact of multipurpose river valley project on it, Out of the 89 species reported belonging to 20 families 25 species were of endemic importance.

Tandon and Thind (1963) found correlation between fishery seasons and harvest season while studying fisheries of the Black Bein, a tributary of river Beas in Punjab. Sehagal (1974) has given a good account of fish and fisheries of Himachal Pradesh. He has reported 44 species of fishes from the streams and rivers of the hill region and described different fishing method. Tandon and Sharma (1965) have reported 48 fish species from the Ghaggar River from Punjab. The workers have also commented on the fishermen's changing occupation. Adholia (1977) worked on the fish fauna of the River Betwa in M.P., he surveyed 31 pools representing 55 fish species out of which 44 species were of commercial importance.

Panchganga river along with tributaries has been the main source of water supply for drinking purpose, irrigation, industrial use for two cities, twelve towns and seventy villages in the Kolhapur district. In order to supply water to the ever

increasing needs of the populations, two dams, namely Radhanagari and tulsi have been constructed across Bhogawati in 1955 and Tulsi in 1978 respectively. In addition 35 Kolhapur Type (K.T.) weirs are constructed all along the river system for storage of water to ensure better water supply for lift irrigation schemes. At present there are around 1285 pumps (total 21967 H.P.) installed on the banks of Panchganga river system.

The reduction in the natural discharge of river water drastically changes the overall ecology of riverine ecosystem affecting the aquatic flora and fauna (Chacko, 1952; Johal and Tandon, 1984). The large number of ever increasing lift irrigation schemes on the river for sugarcane cultivation, industrial purpose and village water supply, often draw so much water that for the first time in the history, in last couple of years, often the river beds in certain areas were left completely dry.

While giving the evidence of the distribution of fresh water fishes along the Western Ghats, Bhimachar (1945) has divided the Ghats into three divisions, viz., a Northern Division, comprising the Deccan trap area from the Tapi river down to 16°N latitude about the level of Goa; a Central Division extending from 16°N latitude southwards and including coorg, Wynaad and parts of South Kanara district and the Nilgiris; and a Southern Division comprising the Anamalai, Palani and Cordomum hills.

The present study area represented the fish diversity of

the Northern Division of the Western Ghats, having considerable Zoogeographical importance. Kulkarni (1951) commented on the records of freshwater fishes from Kolhapur and their significance in the northern section of Western Ghats. Sailas (1951) has given excellent account of Zoogeography and origin of some of the hill fishes from the Southern Western Ghats.

Sailas (1953) reported 14 fish species from the head waters of Krishna River at Wai and Mahabaleshwar in the Western Ghats region of Maharashtra. The earliest records of the riverine fresh water fish fauna of Kolhapur district is by Campbell (1886) which contains only a few local names of fishes and a sketchy account of impression about the 'fisheries', as it was understood at that time. According to the author the then fisheries were of little importance. However, he appeared to have overlooked the vast potential of the fresh water fish resources of the Panchganga river. Kalawar and Kelkar (1956) thoroughly surveyed the river and recorded 71 species of fish. They found out that Labeo fibriatus was the dominant commercial fish species of the river. Other important fish species were Labeo calbasu, Puntius sarana, P.kolus, Wallago attu, Mystus aor, M.armatus, M.seenghala, Channa sp. etc.

The water level fluctuations in the river bed cause great damage to the aquatic organisms. Particularly fish are drastically affected as this physical parameter affects the very survival of food organism, habitat, breeding grounds and upstream migration of several fish species.

Though the river system originates in the hills of Western

Ghats and runs for comparatively short distance, due to the prosperous agriculture in the river basin the development of agro based industries have been noticed in the last few decades. There are 6 Sugar factories 4 distilleries and 1 paper and pulp plant on the river system. Also there are 47 large and 6293 medium and small industrial units of different types like textile, tanneries, metal, chemical, fertilizer etc. All this industrial sector not only makes extensive use of the river water as the only source, but dumps all the wastes in the natural cleaning system. Also untreated sewage from Kolhapur and Ichalkaranji cities is added in the river water.

Construction of dams and weirs, discharge of industrial effluents and domestic wastes have made a great adverse impact on the fish and fisheries of the Panchganga river system. The decline in the fish catch has badly affected a large population of traditional fishermen community of the region namely Bhoi, Bagadi and Koli.

During the present investigations, on many occasions, large scale mass fish mortalities were observed at different locations, mainly due to the discharge of sugar industry and distillery effluents. Also 2-3 times the Kolhapur and Ichalkaranji city water supply was officially terminated for two days at a time in 1986-87 due to the bad quality of water in the river, unfit for human consumption.

During fishing operations many of the fishes reported by Kalawar and Kelkar (1956) three decades ago, are now either rare

or absent. This is attributed to the changes in the river water quality, habitat destruction and change in the ecology of the aquatic environment due the increased human activities.

In 1951 Government of Maharashtra established a fresh water fisheries station at Kolhapur for the development of inland fisheries in the region. The department of fisheries stocked rapidly growing Indian major carps and other exotic fish varieties in Radhanagari reservoir, tanks and rivers. The department also encouraged, the local fishermen to form their co-operative societies. Now there are six fishermen co-operative societies in the area. The fisheries department gives various portions of the river system on annual lease basis to the fishermen societies who in term lease or auction these portions to member fishermen. The fishermen get soft loans and subsidy for purchase of twine, nets and also priority in the auctions of tanks and river portions.

Inspite of the efforts to increase the fishing methods and socio-economic standards of the fishermen community there is done by the same age old fishing gears namely cast net, gill net, drag net and fish traps. Also due to the decline in the fish resource in the river system because of various natural and man made reasons, present status of fisheries is not very encouraging.

To keep pace with the growing demands on the water resource of the Panchganga river and faster commerce and industry in the river basin, the river and its tributaries are further harnessed for power, irrigation and other purposes. These

developments, along with the increasing use of the river for the disposal of various waste materials, have profoundly affected the valuable fishery resource. Therefore it is thought necessary to review the changes in the environment that threaten fish and fisheries in PRS.

Unfortunately no consideration has so far been given by the concerned agencies to the ecological consequences of dams and weirs across the streams and rivers, degradation of forests in the catchment areas, water level fluctuations etc. The biological assessment studies should be conducted, preferably in advance, while planning the projects to study the impact of the changes on the lotic ecosystems.

However, in the developed countries abroad the most recent lotic research has concerned small watersheds, especially head water catchments, which are amenable to monitoring and experimental manipulations. Therefore a global campaign supported by research institutions, governments, UNEP, IUCN and WWF to highlight the need for research of complete river systems, rather than small rivers and streams in isolation is in progress. It would break from the 'Small stream' approach which dominates lotic research for quite some time. According to Davis and Walker, (1986) it is for river systems that the most urgent ecological advice is required.

There has been no previous record of studies on fisheries and the impact of the changing ecological patterns on the fishes of the Panchganga River System. The present study is intended

to provide a review of relevant information and some of the findings on the effects of pollution, silting, water level fluctuations and controls : discharge on the river environment, with emphasis on fisheries resources.

The study was undertaken -

1. To investigate the traditional fishing practices in the river system.
2. To find out the present status of fish with the help of experimental fishing using traditional gears.
3. To try to assess the impact of man made changes in the river system having direct influence on fisheries and fishermen community in general.

About 26 villages on the banks of the five tributaries on river Panchganga were surveyed to get an idea about the fishermen community and their socio-ecological and economic problems.

The experimental fishing operations were conducted at 16 identified traditional fishing grounds using different type of local fishing gear. Part of the huge data generated in the survey and experimental fishing, which is computer analysed, is presented in this dissertation. The results are expected to give a clear cut picture of the present status of fish diversity and problems in fisheries in the river Panchganga.